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Impact of influent quality on green microalgal cultivation with used water resources – experimental assessment combined with image analysis

Dorottya Sarolta Wágner*, Borja Valverde-Pérez, Clarissa Cazzaniga, Michael Steidl, Arnaud Dechesne, Benedek Gy. Plósz

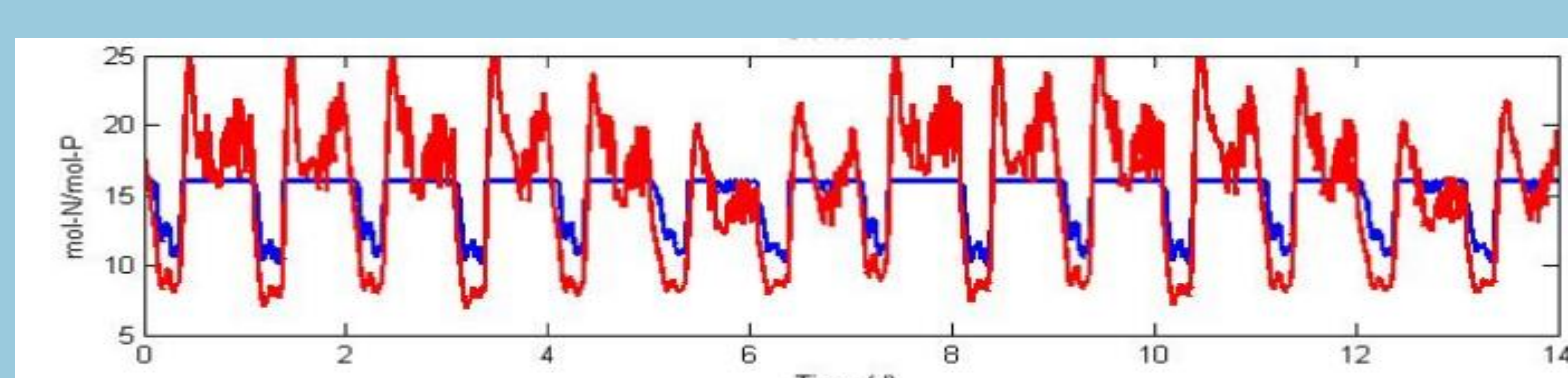
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1. INTRODUCTION

- New technologies are developed to recover wastewater resources → Potential resource recovery (water, nutrients, energy) using microalgae
- Resource recovery through a two-stage bacterial-algal system:
 - Enhanced biological phosphorus removal and recovery system (EBP2R) to produce green microalgal growth medium with optimised N-to-P ratios[1]
 - Optimal algal cultivation, thereby intracellularly storing N and P

EBP2R performance: Control system fails to keep the optimal N-to-P ratio when the nitrogen influent load is low [2]



- This variation of the N-to-P ratio can:
 - Deteriorate PBR performance
 - Alter the microalgal community grown in the PBR

2. OBJECTIVES

- Test the impact of the expected **variability of the EBP2R effluent quality on the algal cultivation and nutrient removal**
- Develop a **method to quantify different microalgal species** within a mixed consortium using **microscopy and image analysis**

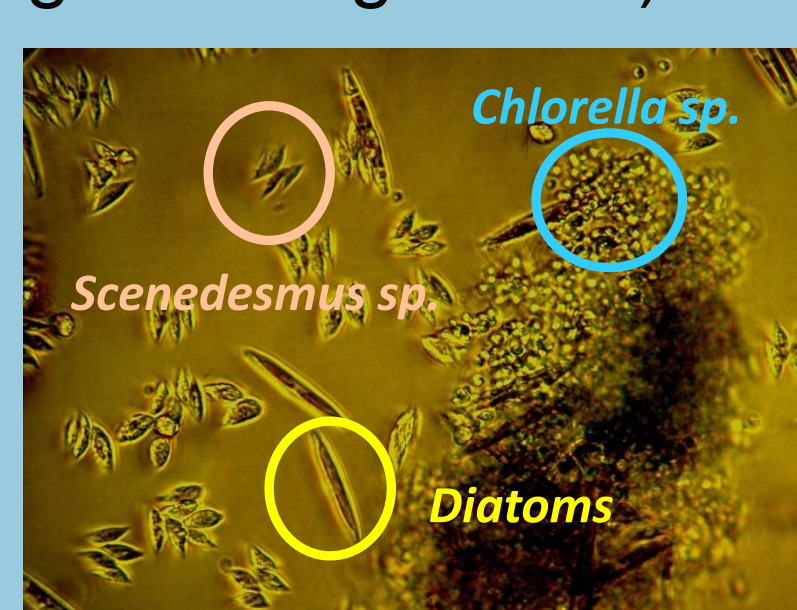
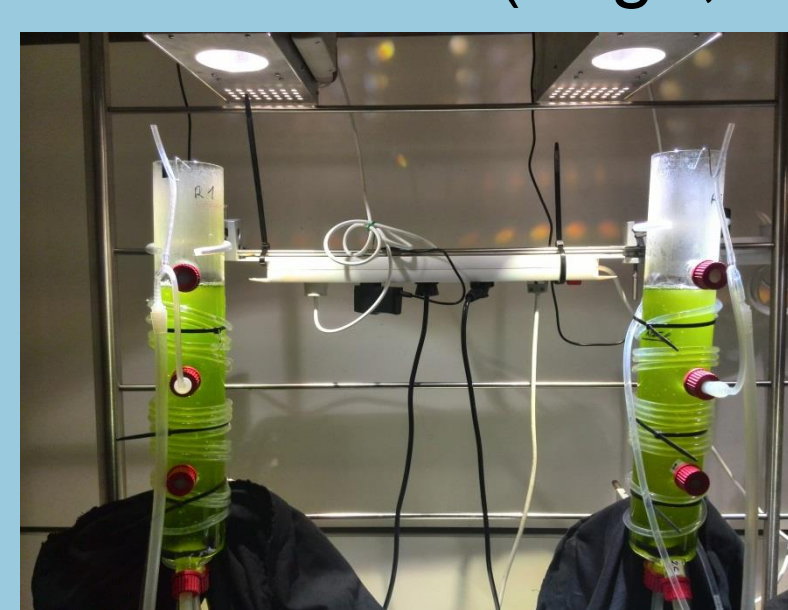
3. MATERIALS AND METHODS

Photobioreactor performance assessed in **lab-scale** reactors:

- 1.4 L open reactors treating the effluent of an EBPR with varying N-to-P ratio
- Two cultivation scenarios:
 - Mixed microalgal consortium of *Chlorella* sp. and *Scenedesmus* sp.
 - Monoculture of *Chlorella* sp.

Microbial diversity analysis and quantification via novel image analysis tool: **shape recognition**

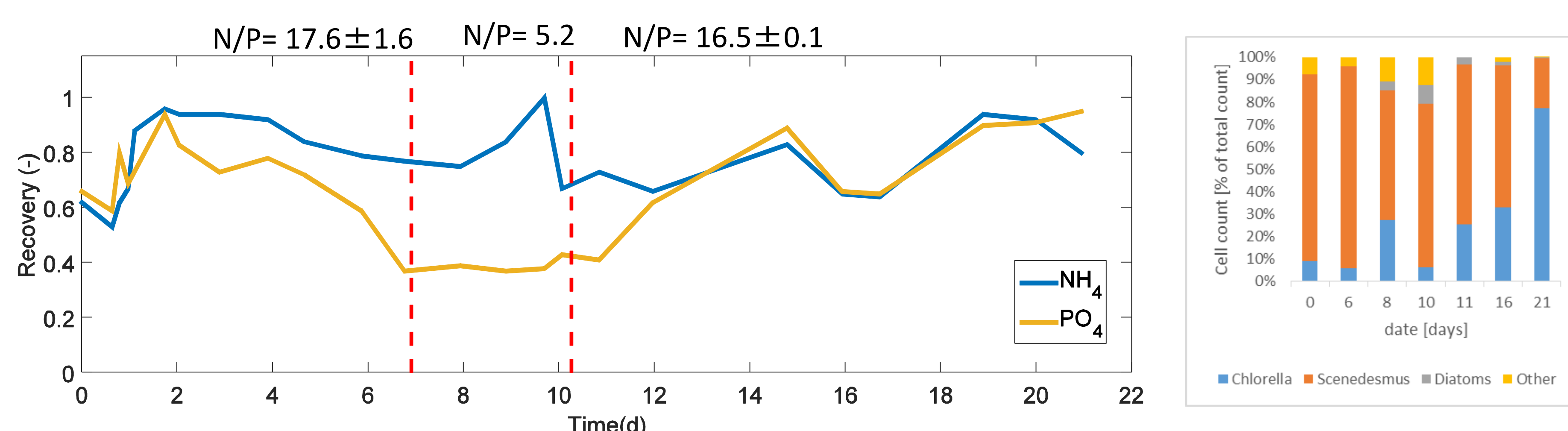
- Chlorella* sp. (round and small individual cells)
- Scenedesmus* sp. (elongated cells arranged in two/four-cell colonies)
- Diatoms (large, elongated single cells)



4. RESULTS

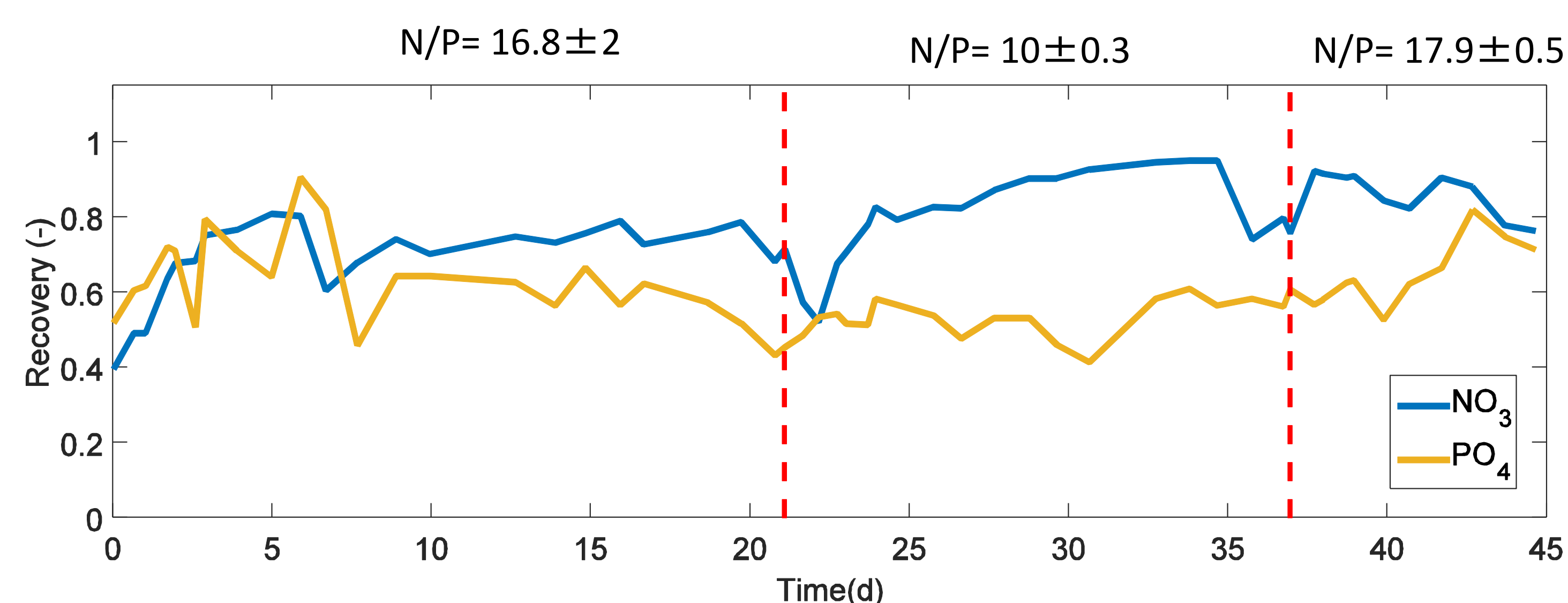
Photobioreactor performance with mixed microalgal consortium

- Culture contamination after shifting the N-to-P ratio to 5 by Diatoms present in the influent
- Poor phosphorus removal (40%) at low N-to-P ratio (due to presence of Diatoms)
- After the N-to-P ratio was shifted back to 17 the Diatoms were washed out and consequently the P removal was recovered



Photobioreactor performance with monoculture of *Chlorella* sp.

- Stable microbial community throughout the cultivation: *Chlorella* sp. (100%)
- Stable phosphorus removal
- Enhanced nitrogen removal after the nitrogen limited period



5. CONCLUSION

- N-to-P ratio** is a powerful tool for **microbial community control** in open PBRs cultivating mixed consortia
- Contamination** by Diatoms can **deteriorate** the process **performance**
- PBR cultivating **monoculture** of *Chlorella* sp. can be operated **without contamination**
- EBP2R can **support optimal algal growth**

ACKNOWLEDGEMENT



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